DEPARTMENT OF THE NAVY
NAVAL WEAPONS CENTER
CHINA LAKE CALIFORNIA 93555-6001

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17 Oct 89

From: Commander, Naval Weapons Center
To: Distribution list of NWC TP 6981

Subj: ERRATA FOR NWC TECHNICAL PUBLICATION 6981, GEOPHYSICAL ALERT BROADCAST USER'S GUIDE, dtd Mar 88

Encl: (1) Changes on pages 3, 7, 8, and 11 for NWC TP 6981

1. Recipients are requested to insert the information from the errata sheet into the above Technical Publication.

William H. Ewin for

B. W. BUTLER
By direction

CHANGES TO NWC TP 6981, *GEOPHYSICAL ALERT BROADCAST USER'S GUIDE*

2 Oct 89

**PAGE 3.: First paragraph of INTRODUCTION, replace existing text with:**

One of the handiest methods to better understand the current state of HF radio propagation conditions is by monitoring the Geophysical Alert Broadcasts made at 18 minutes past each hour over U. S. National Institute of Standards and Technology radio station WWV in Ft. Collins, Colorado and at 45 minutes past the hour via WWVH on the island of Kauai in Hawaii. These stations broadcast continuously on short wave frequencies of 2.5, 5, 10, 15, and 20 MHz (WWVH does not use 20 MHz) with their signals audible throughout North America, the Pacific Region, and often the rest of the world, depending upon radio propagation conditions.

**PAGE 7.: CURRENT INFORMATION, replace italicized text with:**

(Under CURRENT INFORMATION) Change to:

*"Solar-terrestrial indicies for (UTC date) follow: Solar flux (number) and (estimated) Boulder A index (number). Repeat, solar flux (number) and (estimated) Boulder A index (number). The Boulder K index at (UTC time) on (UTC date) was (number), repeat (number)."*

Since the final A index is not available until 0000 UTC, the word "estimated" is used for the 1800 and 2100 UTC announcements.

**PAGE 8.: Second paragraph of A Index section, replace existing text with:**

But there is more to understanding the meaning of the Boulder **A index** reported in the Geophysical Alert Broadcasts. The Boulder **A index** in the announcement is the 24 hour **A index** derived from the eight 3-hour **K indices** recorded at Boulder. The first estimate of the Boulder **A index** is made at 1800 UTC. This estimate uses the six observed Boulder **K indices** available at that time (0000 to 1800 UTC) and the SESC forecaster's best prediction for the remaining two **K indicies**. To make those predictions, SESC forecasters examine present trends and other geomagnetic indicators. At 2100 UTC, the next observed Boulder **K index** is measured and the estimated **A index** reevaluated and updated if necessary. At 0000 UTC, the eighth and last Boulder **K index** is measured and the actual Boulder **A index** is produced. For the 0000 UTC announcement and all subsequent announcements the word "estimated" is dropped and the actual Boulder **A index** is used.

**PAGE 11.: Replace existing NOTE text with:**

The Geophysical Alert Broadcast is also available as a telephone recording. The message can be reached by calling (303) 497-3235.

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19 ABSTRACT (Continue on reverse side if necessary and identify by block number)

(U) This Guide presents an overview of the National Oceanic and Atmospheric Administration's (NOAA) hourly short-wave radio bulletins, which provide constantly updated information on solar-activity-induced effects on the near-earth space environment. The Guide is intended for users with little or no scientific background, as well as for highly technical readers, and provides a step-by-step explanation of the standardized format and terminology the bulletins contain. Specific terms are highlighted and defined in a glossary at the end of the Guide.

(U) Events and phenomena described in the bulletins materially affect the quality of long-distance short-wave radio communications, as well as the nature of the space environment through which many military satellites are passing.

(U) These bulletins are 45 seconds or less in duration and contain a large amount of useful data. Until now, no attempt has been made to provide a systematic method for their use by other than highly technically trained listeners. All information in the broadcasts and in the User's Guide is nonsensitive and unclassified, and is releasable to the general public.

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## CONTENTS

## INTRODUCTION

One of the handiest methods to better understand the current state of high-frequency (HF) radio propagation conditions is by monitoring the Geophysical Alert Broadcasts made at 18 minutes past each hour over the U. S. National Institute of Standards and Technology radio station WWV in Ft. Collins, Colorado. WWV broadcasts continuously on short-wave frequencies of 2.5, 5, 10, 15, and 20 megahertz (MHz), with its signal audible throughout North America and often the rest of the world, depending upon radio propagation conditions.

These 45-second Geophysical Alert Broadcasts, which outline the current nature of the solar-terrestrial environment, are produced by the National Oceanic and Atmospheric Administration's Space Environment Services Center (SESC). This center operates a worldwide network of sensors that continuously observe conditions between the earth and the sun. A listener familiar with the types of information presented can gain a surprising amount of insight into how the natural phenomena primarily responsible for long-distance HF radio communications are affecting it at the moment as well as in the near future.

Updated every 3 hours beginning at 0000 universal time coordinated (UTC), the Geophysical Alert Broadcasts are concerned with two primary types of earth-sun interaction: electromagnetic radiation and geomagnetic activity. The effects of each are summarized below.

## ELECTROMAGNETIC RADIATION

The sun's electromagnetic spectrum is a continuum of radiation spanning not only infrared, visible, and ultraviolet wavelengths, but the radio portions, x-rays, and beyond. Sensors on the earth and in space continuously observe specific portions of the sun's energy spectrum to monitor their levels and give the SESC indications of when significant events occur.

Solar emissions in this category are all electromagnetic in nature; that is, they move at the speed of light. Events detected on the sun in these wavelengths begin to affect the earth's environment only about 8 minutes after they occur.

## GEOMAGNETIC ACTIVITY

In addition to electromagnetic radiation, the sun constantly throws off matter in the form of atomic and subatomic particles. Consisting typically of electrons, protons, and helium nuclei, this tenuous gas is accelerated to speeds in excess of the sun's gravitational escape velocity and thus moves outward into the solar system. The collective term for the gas and the clouds of particles making it up is the solar wind. The sun's approximately 27-day rotation period results in the clouds being slung outward in an expanding spiral pattern that, at the earth-sun distance, overtakes the earth from behind as it moves along in its orbit (see Figure 1).

As the clouds encounter the earth, the geomagnetic field and the earth's atmosphere prevent the solar wind particles from striking the planet directly. Magnetic interactions between the clouds and the geomagnetic field cause the solar wind particles to flow around the field, forming a shell-like hollow with the earth at the center. The hollow, known as the earth's magnetosphere, is actually distorted into a comet shape with the head of the comet always pointing directly into the solar wind and the tail directly away. In the absence of significant solar activity, the solar wind is reasonably uniform with a velocity of approximately 400 kilometers (km)/second. Under these conditions, the earth's magnetosphere maintains a fairly steady shape and orientation in space.

When disturbances occur on the sun, some clouds of solar particles can be blasted away at tremendous velocities. As these higher-speed solar particle clouds encounter the earth's magnetosphere, they perturb it, changing the intensity and direction of the earth's magnetic field. This is analogous to a weather vane in gusty wind; sudden higher-speed gusts can strike the vane and cause it to move around.

Geomagnetic activity, including solar particle-caused variations in the geomagnetic field, are carefully monitored by instruments both on the earth and in space. High levels of geomagnetic activity act to degrade the ability of the

ionosphere to propagate HF radio signals, so they are of interest to users of that portion of the RF spectrum. Like the electromagnetic radiation portions of the sun's output, geomagnetic activity comprises another family of interactions observed and reported by the SESC.

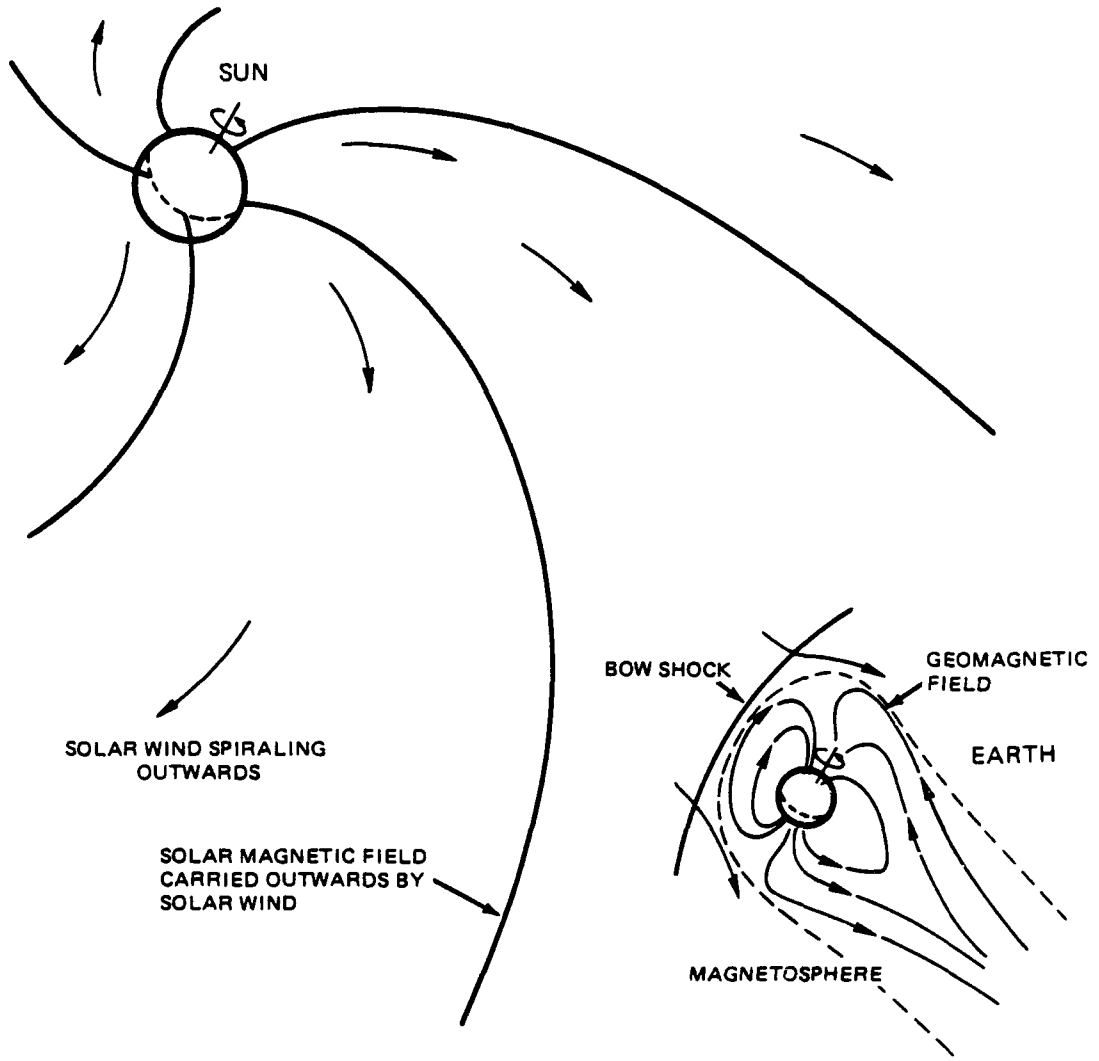


FIGURE 1. The Earth in the Solar Wind.

## GEOPHYSICAL ALERT BROADCASTS

The Geophysical Alert Broadcasts consist of three primary sections to describe the solar-terrestrial environment: the most current information, then a summary of activity for the past 24 hours, and finally a forecast for the next 24 hours. The actual wording of each section of the broadcast is explained below, with a brief description of what is being reported. Terms printed in bold type are defined in Appendix A.

### CURRENT INFORMATION

*"Solar-terrestrial indices for (UTC date) follow: Solar flux (number) and estimated A index (number). Repeat, solar flux (number) and estimated A index (number). The Boulder K index on (UTC date) was (number) repeat (number)."*

#### Solar Flux

Solar Flux is a measurement of the intensity of solar radio emissions at a frequency of 2800 MHz made using a radio telescope located in Ottawa, Canada. Known also as the 10.7-centimeter (cm) flux (the wavelength of the radio signals at 2800 MHz), this solar radio emission has been shown to be proportional to sunspot activity and the level of the sun's **ultraviolet** and **x-ray** emissions primarily responsible for causing ionization in the earth's upper atmosphere. It is these emissions that produce the ionized "layers" involved in propagating HF radio signals over long distances.

The solar flux number reported in the broadcast is in **solar flux units (s. f. u.)** and is recorded daily at Ottawa at 1700 UTC to be forwarded to the SESC. Solar flux readings range from a theoretical minimum of approximately 67 to actually observed numbers greater than 300. Low solar flux numbers dominate during the lower portions of the 11-year **sunspot cycle**, rising as the cycle proceeds, with the average solar flux a fairly reliable indicator of the cycle's long-term behavior.

#### A Index

The **A index** is an averaged quantitative measure of **geomagnetic activity** derived from a series of physical measurements. Magnetometers measure

differences between the current orientation of the magnetosphere and compare it to what it would be under "**quiet**" geomagnetic conditions.

But there is more to understanding the meaning of the **A index** reported in the Geophysical Alert Broadcasts. First, the **A index** in the report is a 24-hour estimate based on four magnetometer measurements made at one station at 3-hour intervals and averaged; this accounts for the first 12 hours of data. Then forecasters at the SESC examine present trends and other geomagnetic indications to project the **A index** used in the broadcast. This is why the broadcast calls it an "estimated" **A index**. Because the first four magnetometer measurements are made from Fredericksburg, Va., this **A index** is also referred to as the "Fredericksburg" **A index**. This process is generally completed by 1800 UTC, so monitoring the Geophysical Alert Broadcast at 1818 UTC should provide the latest estimated **A index** as well as that day's solar flux measurement from Ottawa (see Solar Flux, above).

The underlying concept of the **A index** is to provide a longer-term picture of **geomagnetic activity** using measurements *averaged* either over some time frame or from a range of stations over the globe (or both). Numbers presented as **A indices** are the result of a several-step process: first, a magnetometer reading is taken to produce a **K index** for that station (see K Index below); the **K index** is adjusted for the station's geographical location to produce an **a index** (no typographical error here, small case "a") for that 3-hour period; and finally a collection of **a indices** is averaged to produce an overall **A index** for the time frame or region of interest.

**A** and **a indices** range in value from 0 to 400 and are derived from **K-indices** based on the table of equivalents shown in **Appendix A.**

## K Index

The **K index** is the result of a 3-hourly magnetometer measurement comparing the current **geomagnetic field** orientation and intensity to what it would have been under geomagnetically "**quiet**" conditions. **K index** measurements are made at sites throughout the globe and each is carefully adjusted for the geomagnetic characteristics of its locality. The scale used is quasi-logarithmic, increasing as the **geomagnetic field** becomes more disturbed. **K indices** range in value from 0 to 9.

In the Geophysical Alert Broadcasts, the **K index** used is usually derived from magnetometer measurements made at the Table Mountain Observatory located just north of Boulder. Every 3 hours new **K indices** are determined and the broadcasts are updated.

## CONDITIONS FOR THE PAST 24 HOURS

*"Solar-terrestrial conditions for the last 24 hours follow:*
*Solar activity was (Very low, Low, Moderate, High, or Very high).*
*The geomagnetic field was (Quiet, Unsettled, Active, Minor storm, Major storm, Severe storm)."*
[Optional announcements may be added here (see **Appendix B**).]

### Solar Activity

**Solar activity** is a measure of energy releases in the solar atmosphere, generally observed by **x-ray** detectors on earth-orbiting satellites. Somewhat different than longer-term **solar flux** measurements, solar activity data provide an overview of **x-ray** emissions that exceed prevailing levels.

The five standard terms listed correspond to the following levels of enhanced **x-ray** emissions observed or predicted within a 24-hour period:

| | |
|---|---|
| Very Low | X-ray events less than C-class |
| Low | C-class x-ray events |
| Moderate | Isolated (one to four) M-class x-ray events |
| High | Several (five or more) M-class x-ray events, or isolated (one to four) M5 or greater x-ray events |
| Very High | Several (five or more) M5 or greater x-ray events |

The **x-ray event classes** listed correspond to a standardized method of classification based on the peak flux of the **x-ray** emissions as measured by detectors. Solar x-rays occupy a wide range of wavelengths with the portion used for flare classification from 0.1 through 0.8 nanometer (nm). The classification scheme ranges in increasing **x-ray** peak flux from B-class events, through C- and M-class, to X-class events at the highest end. Further information on **x-ray event classification** is contained in **Appendix A.**

In the Geophysical Alert Broadcasts, **solar activity** data provide an overview of **x-ray** emissions that might have effects on the quality of HF radio propagation. Large solar **x-ray** outbursts can produce sudden and extensive ionization in the lower regions of the earth's **ionosphere** that can rapidly increase HF signal absorption there. Known as "**short wave fades,**" these disturbances can degrade HF communications for from minutes to hours.

### Geomagnetic Activity

As an overall assessment of natural variations in the **geomagnetic field**, six standard terms are used in reporting **geomagnetic activity**. The terminology is based on the estimated **A index** for the 24-hour period directly preceding the time the broadcast was last updated.

| Category | Range of A-index |
|---|---|
| Quiet | 0-7 |
| Unsettled | 8-15 |
| Active | 16-29 |
| Minor storm | 30-49 |
| Major storm | 50-99 |
| Severe storm | 100-400 |

These standardized terms correspond to the range of **a** and **A indices** previously explained in the **A Index** section. Increasing **geomagnetic activity** corresponds to more and greater perturbations of the **geomagnetic field** as a result of variations in the solar wind and more energetic solar particle emissions.

Using the earlier analogy, imagine the **geomagnetic field** to be like a weather vane in an increasingly violent windstorm. As the winds increase, the weather vane is continually buffeted by gusts and oscillates about the direction of the prevailing wind. Essentially, the reported **geomagnetic activity** category corresponds to how violently the **geomagnetic field** is being buffeted about.

For HF radio spectrum users, high **geomagnetic activity** tends to degrade the quality of communications because substantial electrical currents can be induced to flow throughout the effectively conductive **ionosphere**. The currents produce ionospheric heating which, in lower regions, increases HF signal absorption there.

Meanwhile, diminished ionization in higher regions decreases the maximum radio frequency they will refract back earthward. Extended periods of **geomagnetic activity** known as **geomagnetic storms** can last from hours to days. The impact on radio propagation during the storm depends on the level of solar flux and the severity of the **geomagnetic field** disturbance.

## FORECAST FOR THE NEXT 24 HOURS

*"The forecast for the next 24 hours follows:*
*Solar activity will be (Very low, Low, Moderate, High, or Very high).*
*The geomagnetic field will be (Quiet, Unsettled, Active, Minor storm, Major storm, Severe storm)."*
[Optional announcements may be added here (see **Appendix B**).]

### Solar Activity

The quantitative criteria for the **solar activity** forecast are identical to the "conditions for the past 24 hours" portion of the broadcast as explained previously, except that the SESC forecaster is using all available measurement and trend information to make as informed a projection as possible. Some of the key elements in making the forecast include the number and types of sunspots and other regions of interest on the sun's surface, as well as what kinds of energetic events have occurred recently.

### Geomagnetic Activity

The same six standardized terms are used as in the "conditions for the past 24 hours" portion of the broadcast, with the forecast mainly based on current **geomagnetic activity**, recent events on the sun whose effects could influence geomagnetic conditions, and longer-term considerations such as the time of year and the state of the **sunspot cycle**.

NOTE: The WWV Geophysical Alert Broadcast is also available as a telephone recording. The message can be reached by calling (303) 497-3235.

## Appendix A

# GLOSSARY AND OTHER USEFUL INFORMATION

The following information has been extracted from the *SESC Glossary of Solar Terrestrial Terms* and from other sources and may prove useful in understanding the terminology used in this guide and in the Geophysical Alert Broadcasts.

**a index.** A 3-hourly "equivalent amplitude" of **geomagnetic activity** for a specific station or network of stations expressing the range of disturbance of the **geomagnetic field.** The a index is scaled from the 3-hourly **K index** according to the following table:

| K | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| a | 0 | 3 | 7 | 15 | 27 | 48 | 80 | 140 | 240 | 400 |

**A index.** A daily index of **geomagnetic activity** for a specific station or network of stations derived as the average of the eight 3-hourly **a-indices** in a Universal Time day.

**Active.** A descriptive word specifically meaning (1) a probability of $\geq$ 50% for an M-class **x-ray** flare in a sunspot region; (2) disturbed geomagnetic levels such that 16 $\leq$ **Ap index** $\leq$ 30.

**Ap index.** The "planetary" **A index** estimated by statistically weighting near-real-time **geomagnetic field** data from five middle- and upper-latitude reporting stations in the Northern Hemisphere (College, Alaska; Goose Bay, Labrador; Loring Air Force Base, Maine; Boulder, Colorado; and Upper Heyford, Great Britain).

**D region.** A region of the earth's **ionosphere** beginning at approximately 40- to 90-km altitude. Radio wave absorption in layers in this region can be significantly increased in response to increased ionization associated with **solar activity**. The D region is the lowest region of the **ionosphere** and its ionization is strongest during daylight hours.

**E region.** A region of the earth's **ionosphere** roughly between the altitudes of 90 and 160 km. The height and ionization content of the E region depend on the angle of the sun and solar activity. Ionization in the E region is caused mainly by **x-rays** in the wavelength range of 0.8 to 10.4 nm.

**F region.** The upper region of the **ionosphere**, above approximately 160 km. F-region ionization is highly variable, depending on the local time, **solar activity**, season, and **geomagnetic activity**. The F region contains the F1 and F2 layers. The F2, predominantly responsible for long-distance HF radio propagation, is more dense and peaks in ionization at altitudes between 200 and 600 km. The F1 layer, which forms at lower altitudes in the daytime, usually possesses a lesser degree of ionization.

**Flare.** A sudden eruption of energy in the solar atmosphere lasting minutes to hours, from which radiation and particles are emitted. Flares are classified on the basis of area at the time of maximum brightness in the wavelength of 656.3 nm (hydrogen-alpha). Flares are classified according to the following criteria:

Importance 0 (Subflare): $\leq$ 2.0 square degrees
Importance 1: 2.1-5.1 square degrees
Importance 2: 5.2-12.4 square degrees
Importance 3: 12.5-24.7 square degrees
Importance 4: $\geq$ 24.8 square degrees
(1 square degree = 48.5 millionths of the visible solar hemisphere)
A brightness qualifier F, N, or B is generally appended to the importance character to indicate *faint*, *normal*, or *brilliant* (for example 2B).

**Geomagnetic activity.** Natural variations in the **geomagnetic field** classified quantitatively into **quiet, unsettled, active**, and **geomagnetic storm** levels according to the observed **a index** or estimated **A index** (see table at "**Geomagnetic Activity**" under "Past 24 Hours" in text).

**Geomagnetic field.** The magnetic field in and around the earth. The intensity of the magnetic field at the earth's surface is approximately 32,000 nanoteslas (nT) at the equator and 62,000 nT at the magnetic poles.

**Geomagnetic storm.** A worldwide disturbance of the earth's magnetic field distinct from regular daily variations. A storm is precisely defined as occurring when the daily **A index** exceeds 29 (see table at "**Geomagnetic Activity**" under "Past 24 Hours" in text).

**Ionosphere.** The region of the earth's upper atmosphere containing free electrons and ions produced by ionization of atoms there by solar **ultraviolet** radiation at very short wavelengths (< 100 nm) and energetic precipitating particles. The **ionosphere** influences radiowave propagation of frequencies less than about 300 MHz.

**K index.** A 3-hourly quasi-logarithmic local index of geomagnetic activity relative to an assumed quiet-day curve for the recording site. The K index ranges from 0 to 9 and measures the deviation of the most disturbed horizontal component of the **geomagnetic field.**

**Particle flux unit (p. f. u.).** 1 particle/$cm^2$-second-steradian.

**Polar Cap Absorption (PCA).** An anomalous condition of the polar **ionosphere** whereby HF and VHF radio waves are absorbed. PCAs generally originate with major solar **flares** beginning within a few hours of the event and maximizing within a day or two of onset.

**Proton event.** The measurement of proton flux reaching and sustaining $\geq$ 10 **p. f. u.** for at least 15 minutes at energies > 10 MeV by the primary SESC geosynchronous satellite. The start time of the event is defined as the earliest time at which event thresholds have been reached. There are two event thresholds: p10 (a proton event reaching 10 **p. f. u.** at > 10 MeV) and p100 (a proton event reaching 100 **p. f. u.** at 100 MeV).

**Quiet.** A descriptive word specifically meaning (1) a probability of less than 50% for a C-class **x-ray** flare in a sunspot region; (2) **geomagnetic activity** levels such that the **A index** < 8.

**Short Wave Fade (SWF).** An abrupt decrease of HF radio signal strength, lasting from minutes to hours, caused by increased day-side ionization from some solar **flares.**

**Solar activity.** Transient perturbations of the solar atmosphere as measured by enhanced **x-ray** emission, typically associated with **flares.**

**Solar flux unit (s. f. u.).** A quantitative measurement of the sun's radio energy. 1 s. f. u. = $10^{-22}$ watts/square meter hertz = 10,000 jansky.

**Sunspot cycle.** The approximately 11-year quasi-periodic variation in the effective number of sunspots present on the sun's surface. Other solar phenomena, such as **solar activity**, exhibit similar cyclical behavior.

**Ultraviolet (UV).** That part of the electromagnetic spectrum between 5 and 400 nm.

**Unsettled.** With regard to **geomagnetic activity**, a descriptive word between **quiet** and **active** specifically meaning that the **Ap index** is between 8 and 16.

**X-ray.** Electromagnetic radiation of extremely short wavelength (generally less than 1 nm).

**X-ray flare class.** Ranking of a **flare** based on its **x-ray** output. Flares are classified by the SESC according to the order of magnitude of the peak burst intensity (I) measured at the earth in the 0.1- to 0.8-nm-wavelength band as follows:

| Class | Peak, 0.1- to 0.8-nm band (watts/square meter) |
|---|---|
| B | $I < 10^{-6}$ |
| C | $10^{-6} \leq I < 10^{-5}$ |
| M | $10^{-5} \leq I < 10^{-4}$ |
| X | $I \geq 10^{-4}$ |

A multiplier is used to indicate the level within each class. For example:

M6 = $6 \times 10^{-5}$ watts/square meter

## Appendix B

# OPTIONAL ANNOUNCEMENTS ADDED TO GEOPHYSICAL ALERT BROADCASTS

Optional Announcements are occasionally appended to the "Past 24 Hours" and "Forecast for the Next 24 Hours" sections of the broadcast. Those containing standardized terminology are explained below.

"*A (Minor, Major, Severe) geomagnetic storm (began, ended) at (UTC time and date).*"
Terminology used is based on the size of the storm as measured by the **A index** (as given under the **Geomagnetic Activity** section of the "Conditions for the Past 24 Hours" portion of the broadcasts).

"*A major flare occurred at (UTC time and date).*"
Major **flares** are primarily defined in terms of their **x-ray** importance. Information on optical and radio emissions associated with the flare is often given. (See classification scheme under "**flare**" in **Appendix A.**)

"*A proton flare occurred at (UTC time and date).*"
Any **flare** producing significant counts of protons with energies exceeding 10 MeV in the vicinity of the earth.

"*A satellite proton event (is in progress, began at [UTC time and date], ended at [UTC time and date]).*"
A measurement of proton flux reaching and sustaining $\geq$ 10 **p. f. u.** at > 10 MeV as measured by the primary SESC geosynchronous satellite.

"*A polar cap absorption event (is in progress, began at [UTC time and date], ended at [UTC time and date]).*"
**Ionospheric** absorption of HF and VHF (3 to 300 MHz) radio waves in the polar regions.

*"A proton event is expected (UTC time and date)."*
See satellite **proton event** (above) for threshold.

*"Stratwarm Alert (stratwarm exists [UTC time and date])."*
Unexpected large-scale warming of the winter polar atmosphere from the tropopause to the **ionosphere**, characterized by an increase in stratospheric temperatures for several days at a time.

**NOTE:** Additional reports may be made depending upon the nature of the phenomena observed; their intent is to convey as much significant information as possible within the 45-second duration of the total broadcast.

## Appendix C

# ADDITIONAL INFORMATION SOURCES

### SPACE ENVIRONMENT LABORATORY COMPUTER BULLETIN BOARD

Users with a modem-equipped computer can contact the Space Environment Laboratory's public computer bulletin board and obtain additional solar and radio propagation-related data. This board operates 24 hours a day, 7 days a week, and is located in Boulder, Colorado in the United States. Access is free except for any toll charges.

The telephone number is (303) 497-5000. The communications parameters are as follows: 300 or 1200 baud; data word protocol is 8 bits/character with 1 stop bit and no parity. The board is completely menu-driven and contains an extensive Help section.

Available material includes HF propagation reports based on actual operational experience during the previous several hours, regular solar reports that give more extensive data on solar and geomagnetic activity than in the Geophysical Alert Broadcasts, and maximum usable frequency (MUF) predictions based on user-supplied geographic coordinates and actually existing propagation conditions. Data on the board are constantly updated from the Space Environment Laboratory's worldwide data base.

NOTE: This computer bulletin board uses the Bell Standard for its data communications. Many modems outside the U. S. use other standards, so consult your equipment operating instructions before attempting to contact this bulletin board from outside the U. S.

The address of the Space Environment Services Center is as follows:

Space Environment Services Center
NOAA/ERL R/E/SE2
325 Broadway
Boulder, CO 80303
U.S.A
(303) 497-3171